CRWR Online Report 08-08

Trinity River Basin
Environmental Flows Information Collective

FINAL REPORT

by

Eric S. Hersh, M.S.E.

Graduate Research Assistant

and

Kate A. Marney, B.S.

Graduate Research Assistant

and

David R. Maidment, PhD

Principal Investigator

August 31, 2008

Submitted in Fulfillment of TCEQ Project #582-8-75374-114

CENTER FOR RESEARCH IN WATER RESOURCES
The University of Texas at Austin, J.J. Pickle Research Campus, Austin, TX 78712-4497

This document is available online at: http://www.crwr.utexas.edu/online.shtml

Abstract

Access to existing data and documents is a valuable and necessary tool for future scientific and engineering analyses. Some documentation is readily available through various means. Much is currently unavailable, however – a significant detriment to accomplishing the goal of establishing environmental flow needs. This project sought to organize and foster access to documents, reports, and studies. For this demonstration project, the river basin and bay system consisting of the Trinity and San Jacinto Rivers and Galveston Bay forms the study area. The objectives of this project were to create a comprehensive Environmental Flows Document Model that would provide the format and organizing scheme for the incorporation of information from the multiple relevant disciplines; compile representative existing information on the hydrology, biology, physical habitat, physical processes (geomorphology), and chemical processes (water quality, aquatic life uses, etc.) of the study area; and deliver a prototype temporally- and spatially-explicit annotated bibliography of documents, reports, studies, and journal articles pertaining to the study area. In conjunction with the University of Texas Libraries, the DSpace digital repository system was used to capture, store, index, preserve, and redistribute documents.

Acknowledgements

The authors would like to thank the Texas Commission on Environmental Quality (TCEQ) for funding and supporting this research under Project Number #582-8-75374-114. In particular, the contributions of Dr. Wendy Gordon at TCEQ are appreciated. The UT-Austin Cockrell School of Engineering Information Technology Group was helpful in researching and establishing the document management system and the efforts of Lisa Barden and Wendy Harrison are especially appreciated. The authors are also pleased to have the opportunity to work with the University of Texas Libraries as early adopters of the UT digital archive system.

Table of Contents

Introduction

Importance

The 77th Texas Legislature enacted Senate Bill 2 (SB 2) in 2001, establishing the Texas Instream Flow Program. The program is administered by Texas Commission on Environmental Quality (TCEQ), Texas Parks and Wildlife Department (TPWD), and Texas Water Development Board (TWDB) and the purpose is to determine, through scientific and engineering studies, the flow conditions necessary for supporting a sound ecological environment. In May 2007, the 80th Texas Legislature passed Senate Bill 3 (SB3) which sets out the implementation procedures for environmental flow prescriptions in Texas. SB3 disseminates and clarifies rules regarding the issuance and modification of new and existing permits by the TCEQ. Basin-specific science advisory committees must be appointed to "provide an objective perspective and diverse technical expertise, including expertise in hydrology, hydraulics, water resources, aquatic and terrestrial biology, geomorphology, geology, water quality, computer modeling, and other technical areas pertinent to the evaluation of environmental flows." (Texas Legislature 2001, 2007).

Access to existing data is a valuable and necessary tool for future scientific and engineering analyses. However, a significant body of knowledge is already available, developed and cultivated through past analyses and shared through project documentation. Some of this documentation is readily available through existing physical or web-based libraries, some is available through scientific journals, and some is available from various entities and organizations in the State. Much is this information is currently unavailable, however: a significant detriment to accomplishing the requirements and goals of SB3 and other TCEQ and TCEQ-related programs.

A project is underway by the current Principal Investigator, Dr. David Maidment, in FY08-09 to develop an "Environmental Flows Information System," a framework for and comprehensive repository of relevant data (among other deliverables) that could be shared with stakeholders as they embark on the tasks required of them. While that project seeks to organize and foster access to data, the project described herein also seeks to organize and foster access to documents, reports, and studies. The combination of an observations data model, a document model, and a geographic data model forms a

complete information model for environmental flows. For this demonstration project, the river basin and bay system consisting of the Trinity and San Jacinto Rivers and Galveston Bay forms the study area.

Project goals

The objectives of this project were to create a comprehensive Environmental Flows Document Model that would provide the format and organizing scheme for the incorporation of information from the multiple relevant disciplines; compile representative existing information on the hydrology, biology, physical habitat, physical processes (geomorphology), and chemical processes (water quality, aquatic life uses, etc.) of the study area; and deliver a prototype temporally- and spatially-explicit annotated bibliography of documents, reports, studies, and journal articles pertaining to the study area. The first task required a literature and technology review of existing document management systems to determine the format and structure for the document model and hardware and software requirements of a document management system, including possible web-based technologies. The next step was to compile representative existing information published or located from state, federal, academic, and scientific journal sources. The last task was to create a prototype system with a searchable interface and upload electronic versions of the collected documents. A web-based catalog of Texas-specific water data services was also created to aid in data discovery and access. The data catalog includes a simple map viewer custom-built for displaying water information. The project scope of work can be found in **Appendix A**: Scope of Work.

Digital Archives

The Trinity River Basin document collection described herein is an early adopter of a much larger DSpace adoption effort at the University of Texas at Austin and in cooperation with the Texas Digital Library, "a multi-university consortium providing the digital infrastructure to support an online scholarly community for higher education in Texas" (http://www.tdl.org) (Figure 1). The goals of the Texas Digital Library are very much aligned with the goals of this project; TDL seeks to provide:

1. Access to a wide range of digital materials,
2. Long-term preservation of digital collections,
3. Support for the scholarly community, and
4. Aggregation of resources (TDL 2008).

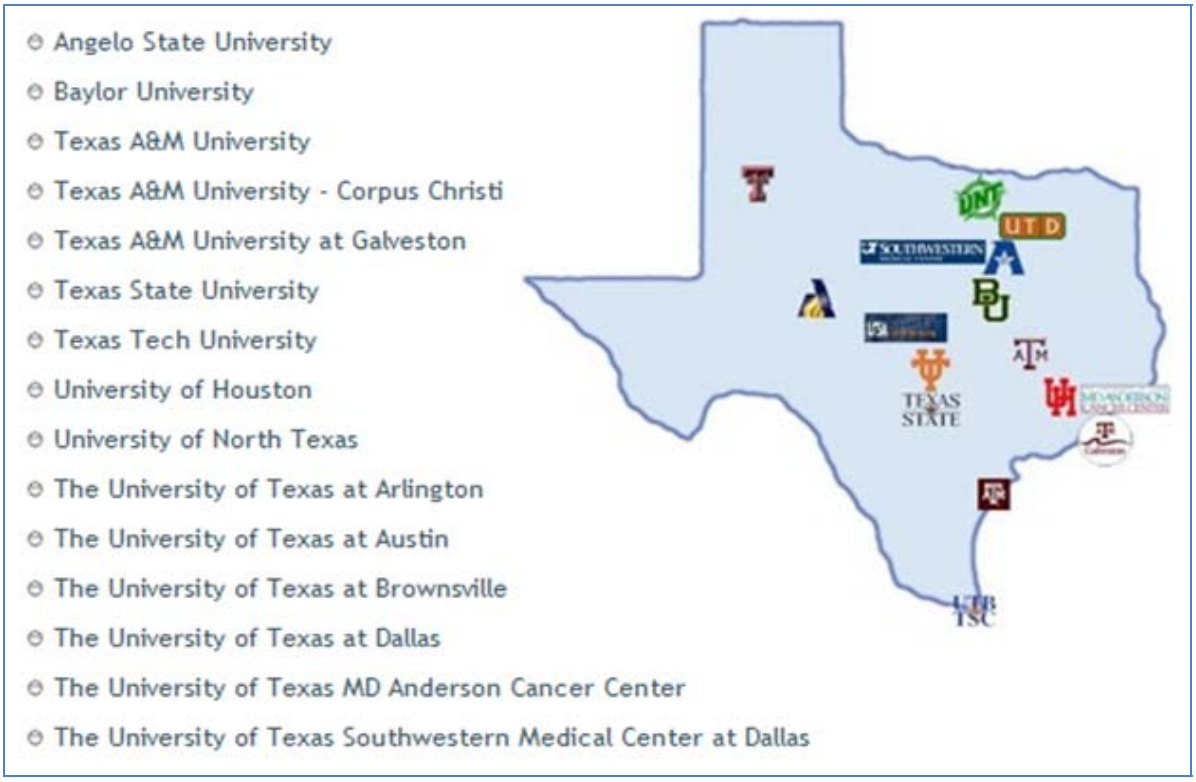


Figure 1. Texas Digital Library member institutions (http://www.tdl.org).

The UT-Austin DSpace Repository (http://repositories.lib.utexas.edu/) was rolled out on September 1, 2008; it's stated purpose is "to collect, record, provide access to, and archive the scholarly and research works of the University of Texas at Austin, as well as works that reflect the intellectual and service environment of the campus." (UT Libraries 2008). The Trinity River Basin falls into the latter category.

Document System

Review of existing systems

Several systems were reviewed in order to make an informed choice for a document management system. Knowledge Tree, Brazos River Instream Flows Study Database, Xythos Server Products, Inmagic Presto, as well as a custom built publication database were all examined in addition to DSpace.

Knowledge Tree (http://www.knowledgetree.com/) is a commercial open source, web-based document management system that is currently licensed by the Aerospace Engineering Department at The University of Texas. This system features a built-in web interface with Lightweight Directory Access Protocol (LDAP) integration, a central document repository with audited document content version control, powerful document metadata management and versioning, and sophisticated document authoring management and workflow. Knowledge Tree also includes full-text indexing technology, allowing search within a document. A powerful security group and role-based security model and integration with Directory Servers make this a very secure system. Also, Knowledge Tree integrates with Windows Desktop Imaging and the Microsoft Office Suite. Though the Aerospace Engineering department is using this product, the current deployment of Knowledge Tree is not set up to handle anonymous access and searches and the program to generate the annotated bibliography would have to be custom built. The overall opinion on this product is that this system is really best suited for document workflow management. There are many features that are related to version control and workflow that does not meet the needs of this project. Implementation of this system in the Aerospace Engineering Department is still very new and unexplored and thus, not necessarily an example to follow (Knowledge Tree 2008).

The Brazos River Instream Flow Study Database is a Microsoft Access database developed by Espey Consultants, Inc. that is used to document reports on the Brazos River Instream Flow Study. This application features Microsoft Access interface for manually entering document metadata and a GIS component to combine access to the database of documents as well as TCEQ supplied data in a spatial representation. The Brazos River IF Study Database also has the ability to generate an annotated bibliography. However, this application does not include web-based searchability and does not contain

an actual document repository; therefore all data would have to be stored separately. Overall, this system fits the needs of the project; however, the licensing process is ambiguous (Espey 2005).

Xythos Server Products (http://www.xythos.com/products/webfile_server.html) are three software suites used to accommodate an institutional repository strategy. This application features categorization of documents to enforce required metadata, secure sharing of documents, APIs (application programming interface) for integration, LDAP (single sign-on) integration, XML import and export, and document scanning integration. Xythos also includes WebDav (Web-based Distributed Authoring and Versioning) access to content, which allows users to collaboratively edit and manage files on remote web servers. On the downside, this application requires existing institutional repository system and quite a bit of custom development would be required to satisfy the scope of the project as the "out of the box" features are mostly back-end and content management. Additionally, there are no built-in temporal or spatial search mechanisms and a public web-based searchable site would have to be built from scratch as would a program to generate the annotated bibliography. Xythos was determined to be unsuitable for the implementation of this project; rather it is better suited for secure document sharing and collaboration (Xythos 2008).

Inmagic Presto (http://www.inmagic.com/products/research/presto.html) is a Web-based application for accessing, sharing, and managing research information and assets that is partnered with WebFeat to provide federated search capability across external data sources. This application has the ability to rapidly find, manage, and act on research assets and features unique "end-to-end" integrated capabilities: search and retrieval, database management, user self-service, and configuration. Inmagic Presto also includes the ability to manage disparate "unstructured" research assets in numerous formats, provides access to research assets immediately after importing into *Presto*, and has only one access point for internal and external research assets from across the organization. The ability to search and browse across multiple database collections is an attractive element. However, Presto cannot generate an annotated bibliography as needed (Inmagic 2008).

The last option considered was a custom built publications database. This option was considered so that a solution still existed if none of the existing systems could conveniently satisfy the requirements of the scope. Since this system would be built to specification, the cost/time to build it would depend on those specifications.

DSpace

DSpace (http://www.dspace.org/) is a digital repository system developed by MIT Libraries and Hewlett-Packard Labs that captures, stores, indexes, preserves, and redistributes an organization's research data and is currently the repository system used by The University of Texas. Digital repositories such as DSpace allow organizations to organize and store a variety of data formats in an accessible and persistent manner. DSpace accepts content such as articles, technical reports, working papers, conference papers, theses, datasets (statistical, geospatial, matlab, etc.), images (visual, scientific, etc.), audio and video files, and reformatted digital library collections. DSpace operates on a logical infrastructure, utilizing metadata for organization and retrieval. Data files, also called bitstreams, are organized together into related sets. Each data file has a technical format and other technical information (DSpace 2008).

Additional information is kept with the data file as metadata. The term metadata means "data about data" and is used to classify content for organization and retrieval. The Trinity River Basin prototype document management system metadata is as follows:

- Title
- Author(s)
- Sponsorship (i.e., organization)
- Date
- Classification (i.e., discipline)
- Subject (i.e., keywords)
- Citation
- Description
- Publisher
- Type (e.g., technical report, article, audio recording)
- URI

In addition, the bitstream (file) is described by:

- File Name
- File Size

- File Format

Storing accurate and useful metadata makes searching for relevant documents simple. The data files that are organized into related sets are then grouped into items. An item is an "archival atom" consisting of grouped, related content and associated descriptions (metadata). An item's exposed metadata is indexed for browsing and searching. Items are organized into collections of logically related material. The highest level of DSpace content hierarchy is a community, a collection of items. A community corresponds to parts of the organization implementing the DSpace such as a department, lab, research center, etc. The end user accesses the files in DSpace via a web interface. Once an item is located, Web-native files can be displayed in a Web browser while other formats can be downloaded and opened with a suitable application program. The Trinity River Basin system can be accessed at http://repositories.lib.utexas.edu/handle/2152/4029 and a screen capture is shown in Figure .

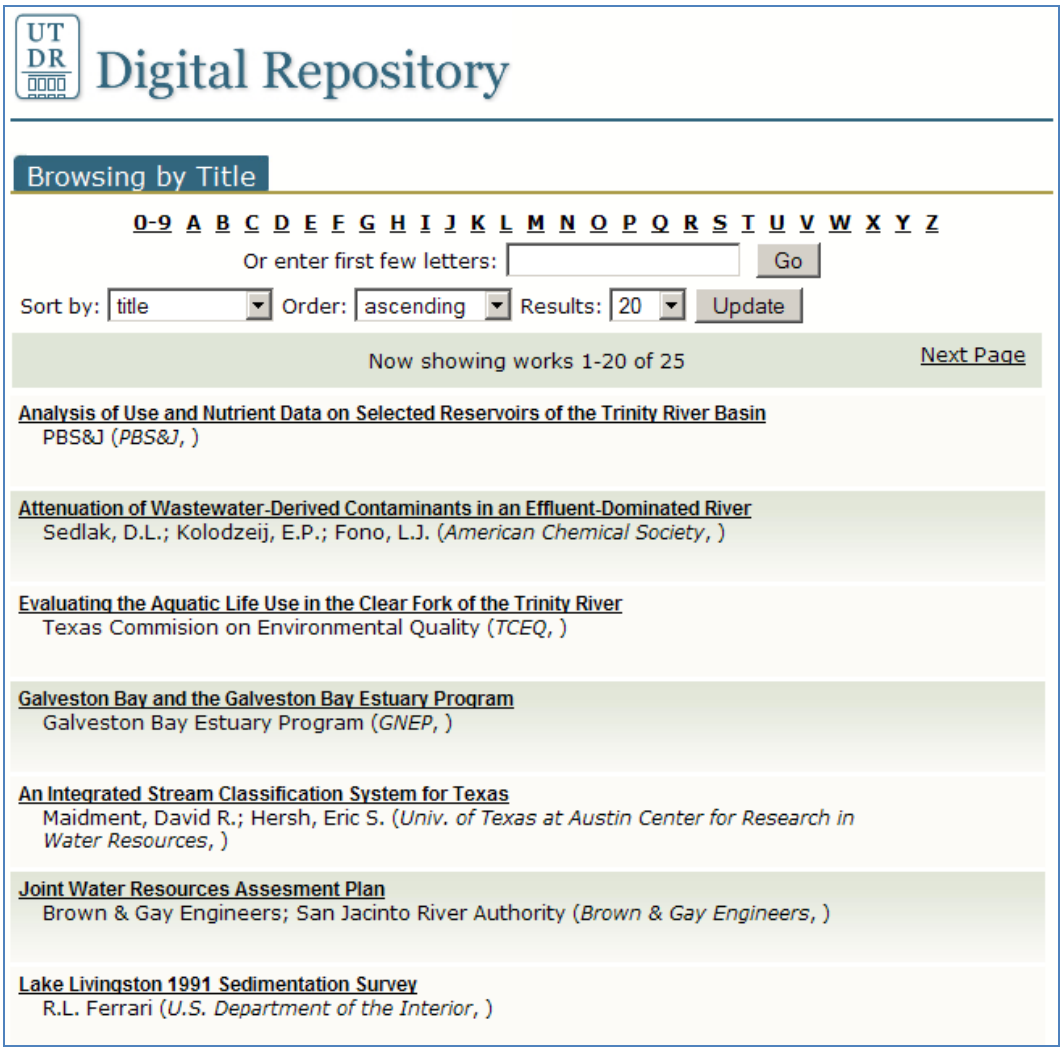


Figure 2. Screen capture of the Trinity River Basin prototype DSpace document management system.

Geographic context

The aforementioned Environmental Flows Information System and a corresponding Texas Water Development Board-sponsored project to develop a Texas Hydrologic Information System both seek to organize and facilitate spatially-explicit access to water data. One common means of accessing these data is through a map interface. It is sometimes the case that the data collected and made available through such information systems were aggregated and analyzed into a journal article, thesis, research report, data summary, study, or other similar document, and the analyses, conclusions, and recommendations from these documents often provide added value. Thus, it is worthwhile to provide parallel access to both the data and the knowledge products derived from that data. A prototype linkage to a georeferenced digital archive of documents (orange polygon in Figure 1) was developed using the same map interface that hosts the data so the user can access both types of information

concurrently. The documents have been represented by polygons instead of points as polygons are believed to be more spatially-explicit and thus provide a more accurate geographic representation of the study area addressed in any given document.

Figure 1. KML-based polygonal geographic representation of the Lower Sabine River Instream Flow Study, depicted alongside the study sampling sites; linkages to both the data and the document are provided from the map interface.

Thus far, example geographic representation of digital documents has been provided via KML (formerly, Keyhole Markup Language) and ESRI shapefiles; the use of Web Feature Services (WFS) is currently being explored by CRWR and the Texas Natural Resources Information System (TNRIS). KML is a geographic language developed and made popular by Google in their Google Earth software; KML has recently been accepted as an Open Geospatial Consortium (OGC) standard (OGC 2008). Shapefiles are a proprietary vector data format of the ESRI software company, providers of the popular ArcGIS line (ESRI 1998). WFS is an OGC interface standard for the communication of geographic data designed to support interoperability in that it is not tied to any specific software program, operating system, or platform (OGC 2008b).

Data System

As an add-on to the original project scope, a web-based catalog of Texas-specific water data services was created to aid in data discovery and access. The data catalog includes a simple map viewer custom-built for viewing water information. Under the auspices of this project and others, significant efforts have been made to find and obtain data for inclusion (via both formal and informal channels) and a catalog of these efforts to-date is available at http://data.crwr.utexas.edu/. The catalog currently includes ten water data services from a variety of data sources, including:

- Federal – National Weather Service
- State – Texas Commission on Environmental Quality, Texas Parks and Wildlife Department, Texas Water Development Board, Texas Coastal Ocean Observation Network, and Texas Instream Flow Program
- Academic – Texas A&M University-Corpus Christi, Texas State University-San Marcos, University of Texas at Austin (Figure 2).

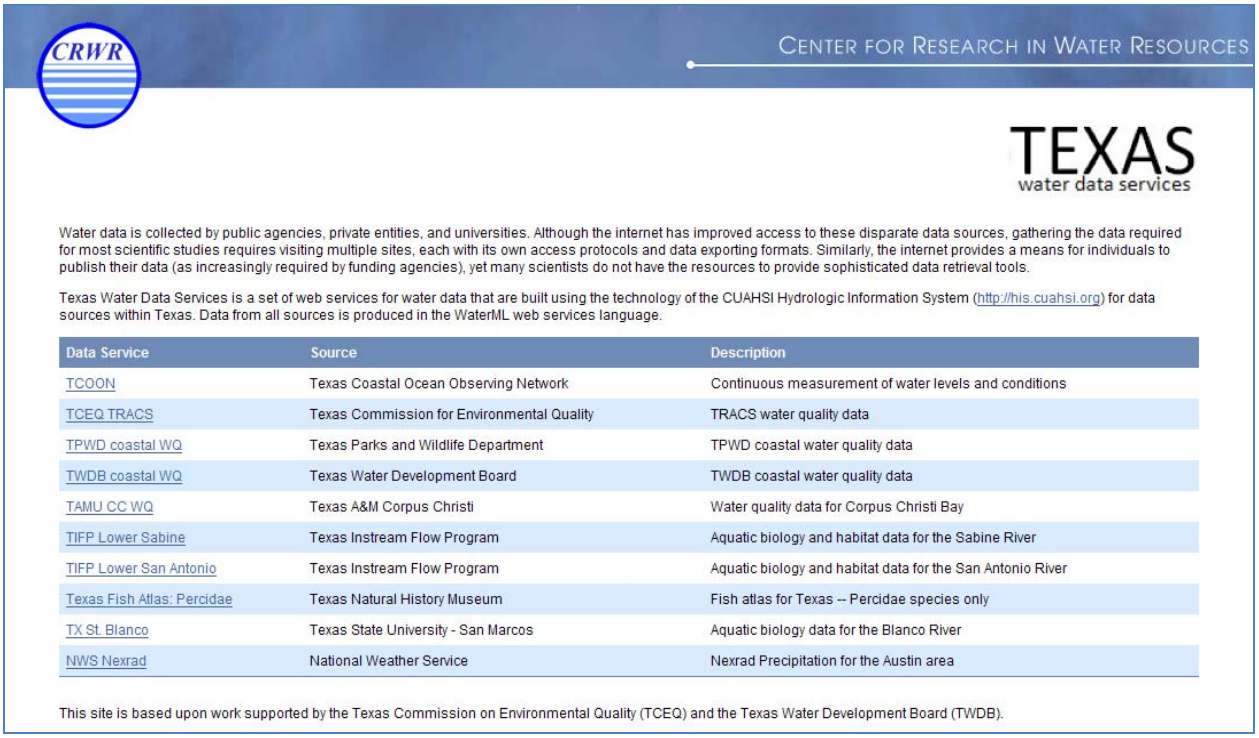


Figure 2. Texas water data services catalog homepage (http://data.crwr.utexas.edu/).

Each of the ten data services currently available via the catalog homepage has its own subpage which lists the data source, a brief description of the data, the web address of the Web Services Definition Language (WSDL) web service contract, the number of sites represented, the number of variables collected, and the total number of values. Also, hyperlinks are provided to the GIS services (map service), the ESRI shapefile of the sampling sites, and Microsoft Excel-based HydroExcel spreadsheets pre-populated with the data, in both the 2003 and 2007 Excel versions. If such a document is available for the data service listed, a hyperlink to the digital document archive is also provided. An example subpage can be found at http://data.crwr.utexas.edu/tceq.html (Figure 3).

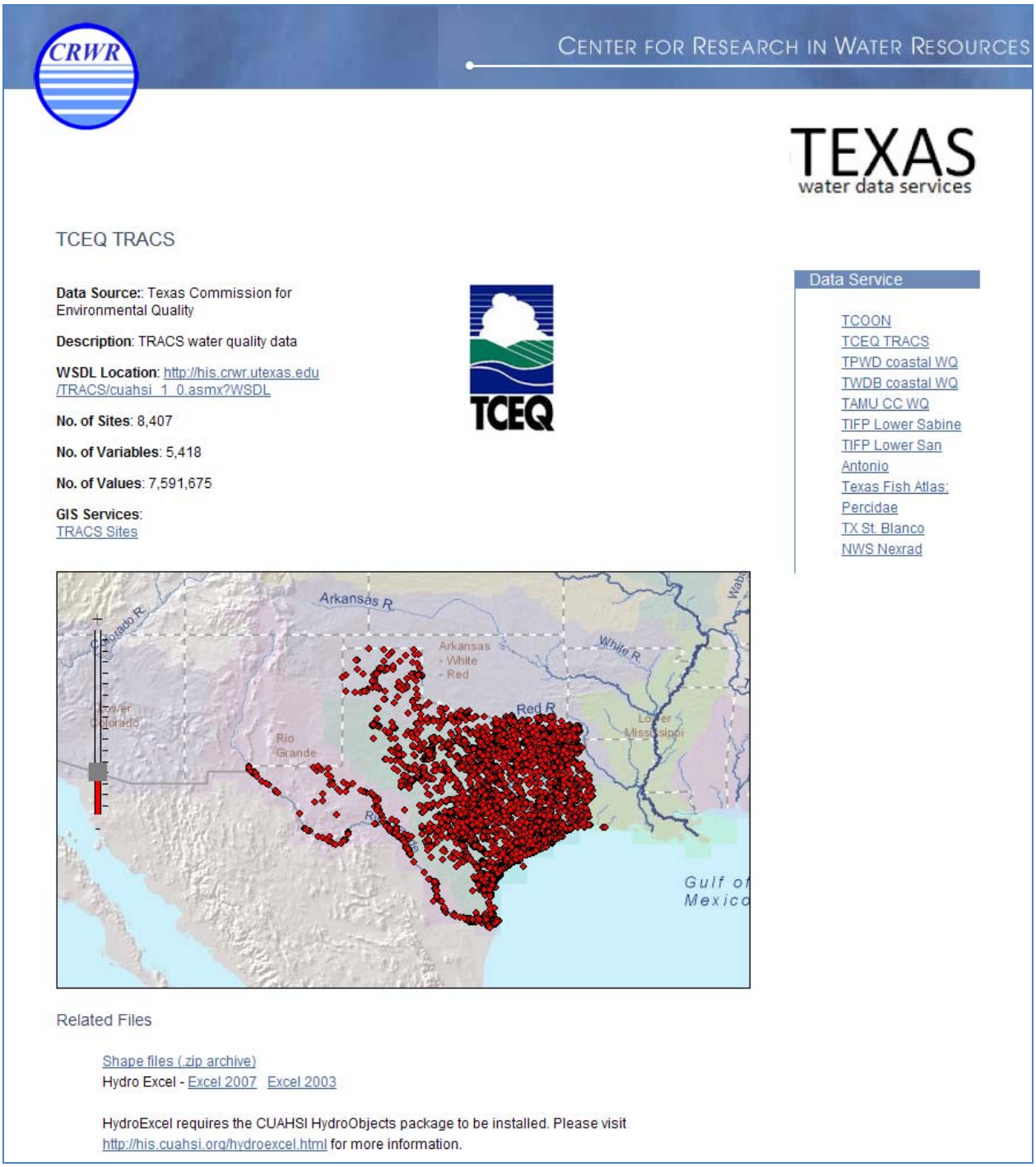


Figure 3. Texas water data services subpage for TCEQ TRACS water quality data (http://data.crwr.utexas.edu/tceq.html).

The basemap visible in Figure 3 was developed by ESRI to support the efforts of the CUAHSI Hydrologic Information System project and the Texas Hydrologic Information System and Environmental Flows Information System projects. The HydroBaseMap includes both geopolitical and hydrological features to

orient the viewer as to their position and to inform them of the drainage areas and water bodies in the vicinity (http://orthogonal.esri.com/ArcGIS/rest/services/USHydroBase2/MapServer).

User guidance

The Trinity River Basin Collection entries are searchable by the majority of the included metadata fields and/or a combination of two to three fields (Figure 4). This search functionality allows for user access to both a specific known document of interest (via a detailed search) and a general query on a range of documents. Examples of the latter include: all documents with the keyword "water quality," all documents authored by Winemiller, all documents from TPWD, or all documents with the subject "Lake Livingston."

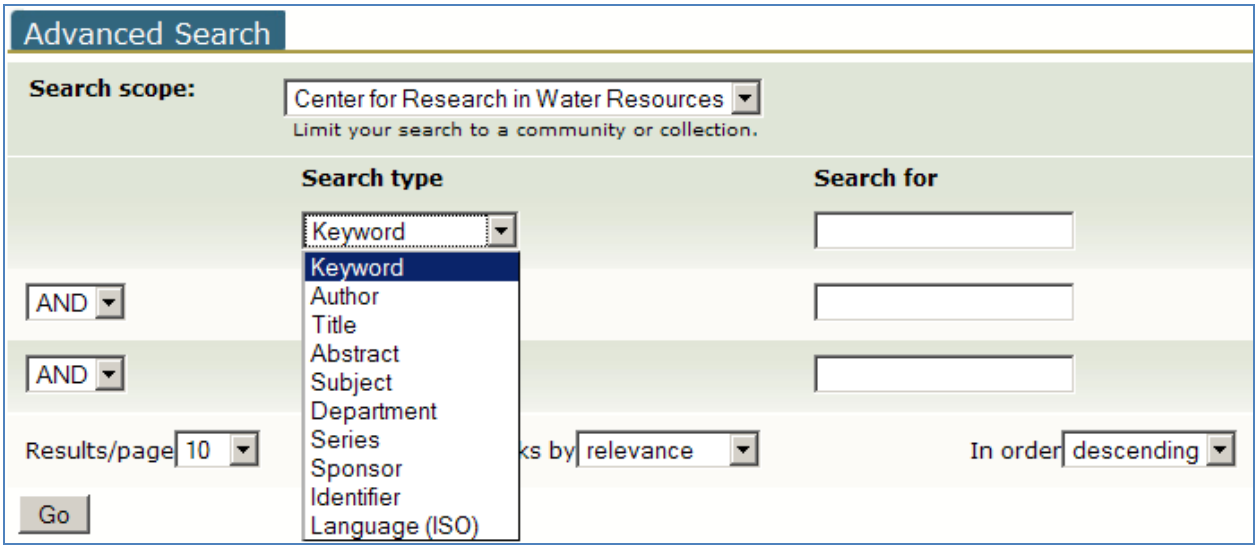


Figure 4. DSpace document search capabilities.

Contributing documents to the collection requires a user account and login; these must be obtained from the collection curator. For the prototype system discussed here, the Information Technology Group of the Cockrell School of Engineering at UT-Austin serves as the collection curator.

Once an account has been established, the document submission process is accomplished via an easy-to-use wizard. Major steps include reviewing and granting a distribution license, uploading the file, providing the metadata, then reviewing the submission and submitting. The DSpace distribution license which must be affirmed to load a document reads:

I grant the University of Texas at Austin ("Institution"), my academic department ("Department"), and the Texas Digital Library ("TDL") the non-exclusive rights to copy, display, perform, distribute and publish the content I submit to this repository ("Work") and to make the Work available in any format in perpetuity as part of an Institution, Department, or TDL repository communication or distribution effort.

I understand that once the Work is submitted, a bibliographic citation to the Work will remain visible in perpetuity, even if the Work is updated or removed.

I understand that the Work's copyright owner(s) will continue to own copyright outside these non-exclusive granted rights.

I warrant that: (1) I am the copyright owner of the Work, or (2) I am one of the copyright owners and have permission from the other owners to submit the Work, or (3) My Institution or Department is the copyright owner and I have permission to submit the Work, or (4) Another party is the copyright owner and I have permission to submit the Work.

Based on this, I further warrant to my knowledge: (5) The Work does not infringe any copyright, patent, or trade secrets of any third party, (6) The Work does not contain any libelous matter, nor invade the privacy of any person or third party, and (7) That no right in the Work has been sold, mortgaged, or otherwise disposed of, and is free from all exclusive claims.

I agree to hold Institution, Department, TDL and their agents harmless for any liability arising from any breach of the above warranties or any claim of intellectual property infringement arising from the exercise of these non-exclusive granted rights. (UT Libraries 2008)

Bibliography

Representative documents and materials pertaining to the Trinity and San Jacinto Rivers and Galveston Bay study area were collected in an annotated bibliography and loaded into the DSpace document system. These documents are not intended to be exhaustive of all study conducted in the basin but rather a cross-section of the types of studies, documents, agencies, and entities involved. Documents from the following sources are included:

- American Society of Civil Engineers
- Galveston Bay Estuary Program
- PBS&J
- San Jacinto River Authority
- Texas A&M University – Galveston
- Texas Christian University
- Texas Commission on Environmental Quality
- Texas Department of Water Resources
- Texas Parks and Wildlife Department
- Texas Water Development Board
- Trinity River Authority
- U.S. Bureau of Reclamation
- U.S. Department of Agriculture Natural Resource Conservation Service
- U.S. Fish and Wildlife Service
- United States Geological Survey
- University of California
- University of Kentucky
- University of Texas at Austin

Appendix B: Annotated Bibliography is a complete table of the documents included and their respective metadata. Additionally, a CD-ROM has been provided with this report which includes electronic copies of all of the documents. Documents from local, state, and federal public entities along with numerous academic sources and some private entities are represented in the annotated bibliography. Potential additional sources for inclusion include, among others:

- Baylor University
- Houston Advanced Research Center
- National Wildlife Federation
- Sierra Club
- Texas A&M University – College Station
- Texas Natural Resource Conservation Commission
- Texas Tech University
- The Nature Conservancy
- University of Houston – Clear Lake
- University of North Texas
- University of Texas at Dallas

Conclusion

After a comprehensive literature review of several different existing applications, DSpace was identified as the best fit for this project. DSpace is a digital repository system that captures, stores, indexes, preserves, and redistributes an organization's research data. DSpace offers powerful search capabilities due to the manner in which it stores metadata. Once DSpace was chosen as the best application for this project, a prototype system was developed.

Future goals include adding more documents and datasets to the repository to create a more robust system. This goal, however, is met with the challenge of understanding how to manage copyrighted material. In the science and engineering fields, many researchers' material is published in various journals, keeping the papers from being available to the general public. This is one of the limitations of the system as well and if no solution is found the document management system will be limited to public reports such as those written for and by public agencies and universities. Since DSpace is the repository system used by The University of Texas, another future goal is to set up all users with a UT Library login such that external users' documents can be loaded into the system.

It is the authors' hope that, by facilitating access to relevant data and documents, the best available science will be brought to the table when making decisions concerning environmental flow needs. The Trinity River Basin Environmental Flows Information Collective discussed herein is a step toward providing the necessary access to such documents.

References

77th Texas Legislature. (2001). “Senate Bill 2.”

80th Texas Legislature. (2007). “Senate Bill 3.”

DSpace. (2008). “DSpace.” Developed by the MIT Libraries and Hewlett-Packard, Inc. Accessed March 2008. http://www.dspace.org/

Espey Consultants, Inc. (2005). “Brazos River Basin Reconnaissance Instream Flows Analysis, EC Project Number 3033.300.” Prepared for the Texas Parks and Wildlife Department, August 1, 2005.

ESRI. (1998). “ESRI Shapefile Technical Description – An ESRI White Paper.” July 1998. http://www.esri.com/library/whitepapers/pdfs/shapefile.pdf

Inmagic, Inc. (2008). “Inmagic Presto.” Accessed March 2008. http://www.inmagic.com/products/research/presto.html

Knowledge Tree Inc. (2008). “Knowledge Tree.” Accessed March 2008. http://www.knowledgetree.com/

Open Geospatial Consortium. (2008). “OGC KML.” Accessed October 2008. http://www.opengeospatial.org/standards/kml/

Open Geospatial Consortium. (2008b). “Web Feature Service.” Accessed October 2008. http://www.opengeospatial.org/standards/wfs

Texas Digital Library. (2008). “Texas Digital Library.” Accessed September 2008. http://www.tdl.org.

The University of Texas at Austin Libraries. (2008). “UT DSpace Repository.” Accessed October 2008. http://repositories.lib.utexas.edu/

Xythos Software, Inc. (2008). “Xythos WebFile Server.” Accessed March 2008. http://www.xythos.com/products/webfile_server.html

Appendix A: Scope of Work

Background: The 80th Texas Legislature passed Senate Bill 3 (SB3) in May 2007 which sets out the implementation procedures for environmental flow prescriptions in Texas. SB3 promulgates and clarifies rules regarding the issuance and modification of new and existing permits by the TCEQ. Basin-specific science advisory committees must be appointed to "provide an objective perspective and diverse technical expertise, including expertise in hydrology, hydraulics, water resources, aquatic and terrestrial biology, geomorphology, geology, water quality, computer modeling, and other technical areas pertinent to the evaluation of environmental flows."

A current project is underway by the current Principal Investigator, Dr. David Maidment, in FY08-09 to develop an "Environmental Flows Information System," a framework for and comprehensive repository of relevant data (among other deliverables) that could be shared with stakeholders as they embark on the tasks required of them. While that project seeks to organize and foster access to data, this proposed project seeks to organize and foster access to documents, reports, and studies. The combination of a data-focused model for environmental flows and a document-based model for environmental flows forms a complete information model for environmental flows. The river basin and bay system consisting of the Trinity and San Jacinto Rivers and Galveston Bay will form the study area for this project.

Access to existing data is a valuable and necessary tool for future scientific and engineering analyses. However, a significant body of knowledge is already available, developed and cultivated through past analyses and shared through project documentation. Some of this documentation is readily available through existing physical or web-based libraries, some is available through scientific journals, and some is available from various entities and organizations in the State. Much is this information is currently unavailable, however: a significant detriment to accomplishing the requirements and goals of SB3 and other TCEQ and TCEQ-related programs.

Objective: Objectives of this project are: (1) Create a comprehensive Environmental Flows Document Model that would provide the format and organizing scheme for the incorporation of information from the multiple relevant disciplines; (2) Compile representative existing information on the hydrology, biology, physical habitat, physical processes (geomorphology), and chemical processes (water quality, aquatic life uses, etc.) of the study area; and (3) deliver a prototype temporally- and spatially-explicit annotated bibliography of documents, reports, studies, and journal articles pertaining to the study area.

It is envisioned that this project will serve as the vehicle to develop a prototypical document management system specific to environmental flows information. The Trinity and San Jacinto Rivers and Galveston Bay will comprise the test case for the development and testing of the prototypical system and a subset of all available data from multiple relevant disciplines will be incorporated in this phase of the project. Based on the results of this project, a second phase (separate project) might be considered

to refine the document system and also to provide the remaining information content (all known existing relevant information) for the Trinity-San Jacinto-Galveston bay and basin system.

Task 1 Create a comprehensive Environmental Flows Document Model. Perform a literature and technology review of existing similar systems to determine the format and structure of the document model and the hardware and software requirements of a document management system, including possible web-based technologies.

Task 2 Compile representative existing relevant information published or located from state, federal, academic, river authority, private, and scientific journal sources, such as:

- State agencies: TCEQ, TPWD, TWDB, predecessor agencies;
- Federal agencies: USGS, USFWS, USBR, USACOE;
- River authorities and Water Districts: TRA, SJRA;
- University studies; and
- Scientific journals.

Task 3 Deliver a prototype temporally- and spatially-explicit annotated bibliography consisting of the documents identified in Task 2. The bibliography will include a searchable interface indexed by such identifiers as:

- Author/Organization
- Date
- Location (City, County, Subbasin, Waterbody, etc.)
- Discipline
- Keywords (variables, species, etc.)

The annotated bibliography will include electronic versions (such as Abode Portable Document Format or PDF) of the representative documents identified and collected under Task 2.

Deliverables (1) A summary report including findings from Task 1, a description of the Environmental Flows Document Model, and user documentation and guidance.
(2) An annotated, searchable bibliography (as described in Task 3), including electronic copies of the representative documents incorporated.

Appendix B: Annotated Bibliography

University of Texas Libraries

Repository Home > Browsing by Title

UT DR Digital Repository

Browsing by Title

0-9 A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Or enter first few letters: Go

Sort by: title Order: ascending Results: 20 Update

Now showing works 1-20 of 25 Next Page

Analysis of Use and Nutrient Data on Selected Reservoirs of the Trinity River Basin
PBS&J (*PBS&J*,)

Attenuation of Wastewater-Derived Contaminants in an Effluent-Dominated River
Sedlak, D.L.; Kolodzeij, E.P.; Fono, L.J. (*American Chemical Society*,)

Evaluating the Aquatic Life Use in the Clear Fork of the Trinity River
Texas Commision on Environmental Quality (*TCEQ*,)

Galveston Bay and the Galveston Bay Estuary Program
Galveston Bay Estuary Program (*GNEP*,)

An Integrated Stream Classification System for Texas
Maidment, David R.; Hersh, Eric S. (*Univ. of Texas at Austin Center for Research in Water Resources*,)

Joint Water Resources Assesment Plan
Brown & Gay Engineers; San Jacinto River Authority (*Brown & Gay Engineers*,)

Lake Livingston 1991 Sedimentation Survey
R.L. Ferrari (*U.S. Department of the Interior*,)

Modeling of runoff-producing rainfall hyetographs in Texas using L-moment statistics
Sharp, John M.; Asquith, William H. (*The University of Texas at Austin*,)

Monitoring Report for Bacterial Source Tracking, Segments 0806, 0841, and 0805 of the Trinity River, Bacteria TMDL
James Miertschin & Associates, Inc.; Parsons Water & Infrastructure, Inc.; Institute for Environmental Health: Texas Institute for Applied Environmental

PC-Based Decision-Support System for Trinity River, Texas
Killen, J.R.; Ford, D.T. (*ASCE*,)

Quantifying downstream impacts of impoundment on flow regime and channel planform, lower Trinity River, Texas
Phillips, J.D.; Slattery, M.C.; Wellmeyer, J.L. (*Geomorphology*,)

Regionalization of the Index of Biotic Integrity for Texas Streams
Mayes, K.B.; Kleinsasser, L.J.; Linam, G.W. (*TPWD*,)

Reptiles & Amphibians of the Trinity River Refuge
U.S. Fish and Wildlife Service (*Fish and Wildlife Service*,)

A seasonal survey of carbohydrates and uronic acids in the Trinity River, Texas
Santschi, P.H.; Warnken, K.W.; Hung, C.C. (*Organic Geochemistry*,)

Sediment budgeting in the upper and middle basins of the Brazos and Trinity Rivers, TX: an assessment of methods and directions for future work
Slattery, M.C. (*TWDB*,)

The State of the Bay
McFarlane, Robert W.; Shipley, Frank S.; Bedient, Philip B; Rifai, Hanadi S.; Newell, Charles J. (*The Galveston Bay National Estuary Program*,)

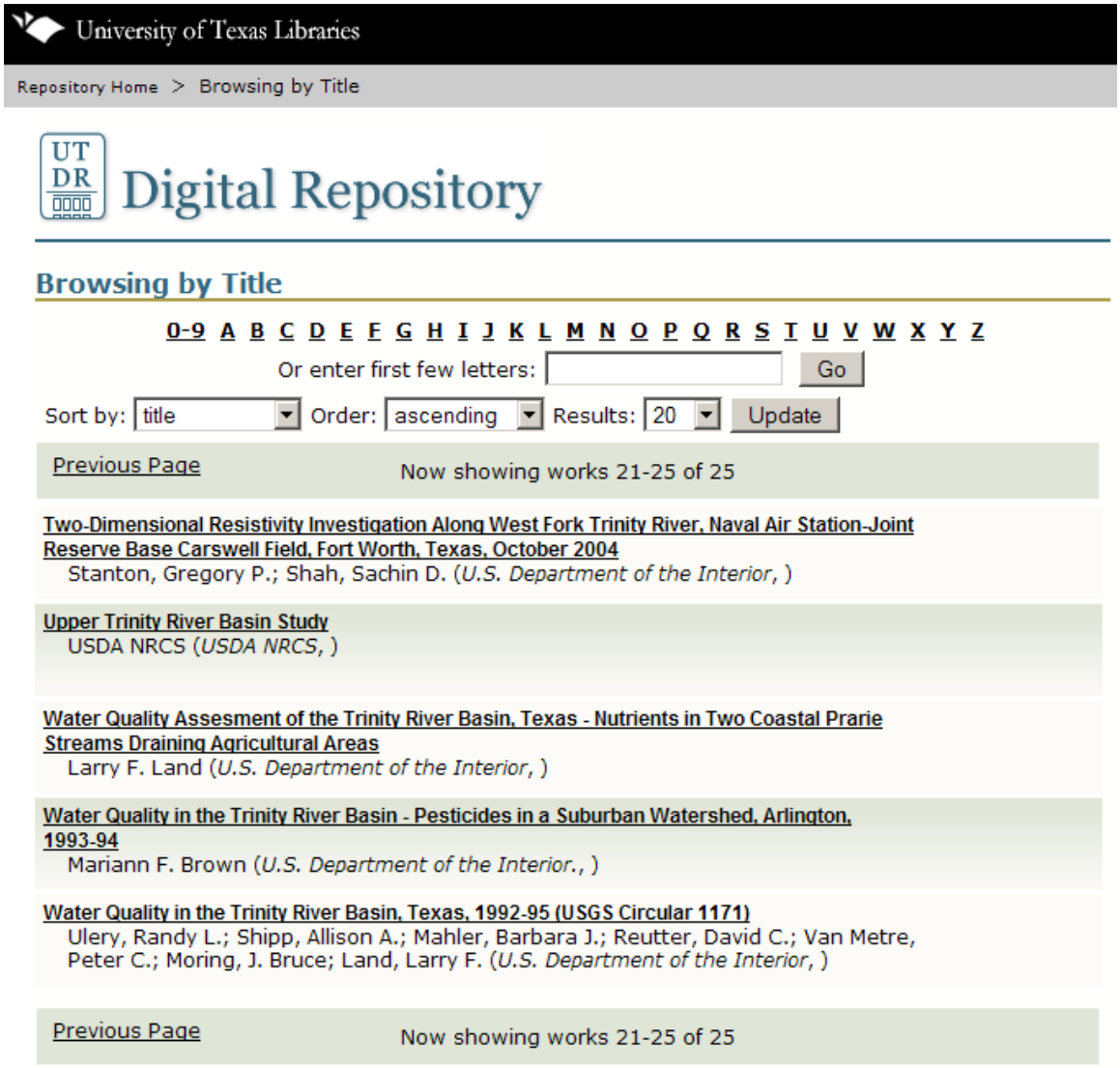
Status of Biotic Integrity, Water Quality, and Physical Habitat in East Texas Wadeable Streams
and 13 others; Kleinsasser, L.J. (*TPWD*,)

Trinity River Authority 2008 Basin Highlights Report
Trinity River Authority (*Trinity River Authority*,)

Trinity River Basin Master Plan
Trinity River Authority (*Trinity River Authority*,)

Trinity-San Jacinto Estuary: A Study of the Influence of Freshwater Inflows
TX DWR (*TX DWR*,)

Now showing works 1-20 of 25 Next Page



http://repositories.lib.utexas.edu/handle/2152/4029/browse?type=title

No.	Title	Author	Organization	Year	Discipline	KeyWords
1	Trinity-San Jacinto Estuary: A Study of the Influence of Freshwater Inflows	Texas Dept. of Water Resources	Texas Dept. of Water Resources	1981	hydrology; biology	freshwater inflows; bays; estuaries; productivity; fisheries
2	Lake Livingston 1991 Sedimentation Survey	R.L. Ferrari	US Department of the Interior, Bureau of Reclamation	1993	physical processes	sedimentation; dam;
3	The State of the Bay, A Characterization of the Galveston Bay Ecosystem	C.J. Newell, H.S. Rifai, P.B. Bedient, F.S. Shipley, R.W. McFarlane	GBEP	1994	biology, water quality	environmental management; estuary; coastal ecosystem;
4	PC-Based Decision-Support System for Trinity River, Texas	D.T. Ford, J.R. Killen	ASCE	1995	planning and management	floodwater management; decision support system; reservoir operations
5	Upper Trinity River Basin Study	U.S. Department of Agriculture Natural Resource Conservation Service	TWDB	1995	water quality, hydrology	SWAT; modeling; sediment; nutrients; BMPs
6	Water Quality in the Trinity River Basin - Pesticides in a Suburban Watershed, Arlington, 1993-94	M.F. Brown	USGS, US Dept. of the Interior	1995	water quality	pesticides; suburban watershed;
7	Water Quality Assesment of the Trinity River Basin, Texas - Nutrients in Two Coastal Prarie Streams Draining Agricultural Areas	L.F. Land	USGS, US Dept. of the Interior	1996	water quality	coastal prarie; agriculture; chemicals; nutrients;
8	Water Quality in the Trinity River Basin, Texas, 1992-95 (USGS Circular 1171)	L.F. Land, J.B. Moring, P.C. Van Metre, et al.	USGS	1998	water quality	nutrients; pesticides; sediment; organochlorines; habitat; semipermeable membrane device
9	Regionalization of the Index of Biotic Integrity for Texas Streams	G.W. Linam, L.J. Kleinsasser, K.B. Mayes	TPWD	2002	biology	aquatic life use; biotic integrity; macroinvertebrate; fish; ecoregions
10	Analysis of Use and Nutrient Data on Selected Reservoirs of the Trinity River Basin	PBS&J	PBS&J	2003	water quality	nutrients; reservoirs; EPA; plant growth;

11	Modeling of runoff-producing rainfall hyetographs in Texas using L-moment statistics	W.H. Asquith & J. M. Sharp	Univ. of Texas at Austin	2003	hydrology	hydrology; civil engineering; geology
12	Reptiles & Amphibians of the Trinity River Refuge	U.S. Fish and Wildlife Service	USFWS	2004	biology	reptiles; amphibians
13	Status of Biotic Integrity, Water Quality, and Physical Habitat in East Texas Wadeable Streams	L.J. Kleinsasser, et al.	TPWD	2004	biology; water quality	habitat; biotic integrity; East Texas; fish; invertebrates; ecoregions
14	Two-Dimensional Resistivity Investigation Along West Fork Trinity River, Naval Air Station-Joint Reserve Base Carswell Field, Fort Worth, Texas, October 2004	S.D. Shah, G.P. Stanton	USGS, US Dept. of the Interior	2004	water quality	groundwater; contamination; resistivity profile;
15	A seasonal survey of carbohydrates and uronic acids in the Trinity River, Texas	C.C. Hung, K.W. Warnken, P.H. Santschi	Texas A&M Univ. at Galveston, Laboratory for Oceanographic and Env. Research	2005	water quality	carbohydrates; uronic acids; nutrients; trace metals
16	Quantifying downstream impacts of impoundment on flow regime and channel planform, lower Trinity River, Texas	J.L. Wellmeyer, M.C. Slattery, & J.D. Phillips	TCU Dept. of Geology & UK Dept. of Geography	2005	geomorphology	Impoundment; regulated discharge; channel planform change; Trinity River
17	Attenuation of Wastewater-Derived Contaminants in an Effluent-Dominated River	L. J. Fono, E.P. Kolodzeij, D.L. Sedlak	Univ. of California Dept. of Civil and Env. Engr.	2006	water quality	contaminant attenuation; biotransformation; municipal wastewater
18	Monitoring Report for Bacterial Source Tracking, Segments 0806, 0841, and 0805 of the Trinity River, Bacteria TMDL	Texas Inst. for Applied Env. Research, Inst. for Env. Health, Parsons Water & Infrastructure, Inc., James Miertschin & Associates, Inc.	TCEQ	2006	water quality	bacteria; Total Maximum Daily Load; source tracking
19	An Integrated Stream Classification System for Texas	Hersh, E.S. and Maidment, D.R.	Univ. of Texas at Austin Center for Research in Water Resources	2007	biology, hydrology, geomorphology, water quality	stream classification; instream flows; climatology; ecoregions
20	Evaluating the Aquatic Life Use in the Clear Fork of the Trinity River	Texas Commision on Environmental quality Total Maximum Daily Load Program	TCEQ	2007	water quality	Total Maximum Daily Load; Clear Fork; dissolved oxygen; aquatic life;

21	Galveston Bay and the Galveston Bay Estuary Program	Galveston Bay National Estuary Program	GBEP	2007	biology, water quality, management	environmental management; estuary; coastal ecosystem;
22	Sediment budgeting in the upper and middle basins of the Brazos and Trinity Rivers, TX: an assessment of methods and directions for future work	M.C. Slattery, TCU	TWDB	2007	geomorphology	sediment budget; sediment transport; alluvial storage; morphology; erosion
23	Trinity River Basin Master Plan	Trinity River Authority	TRA	2007	planning and management	conservation; management; planning
24	Joint Water Resources Assessment Plan	San Jacinto River Authority	SJRA	2008	planning and management	management; WRAP; water demand; groundwater;
25	Trinity River Authority 2008 Basin Highlights Report	Trinity River Authority	TRA	2008	water quality	monitoring; drought; stakeholder; permitting